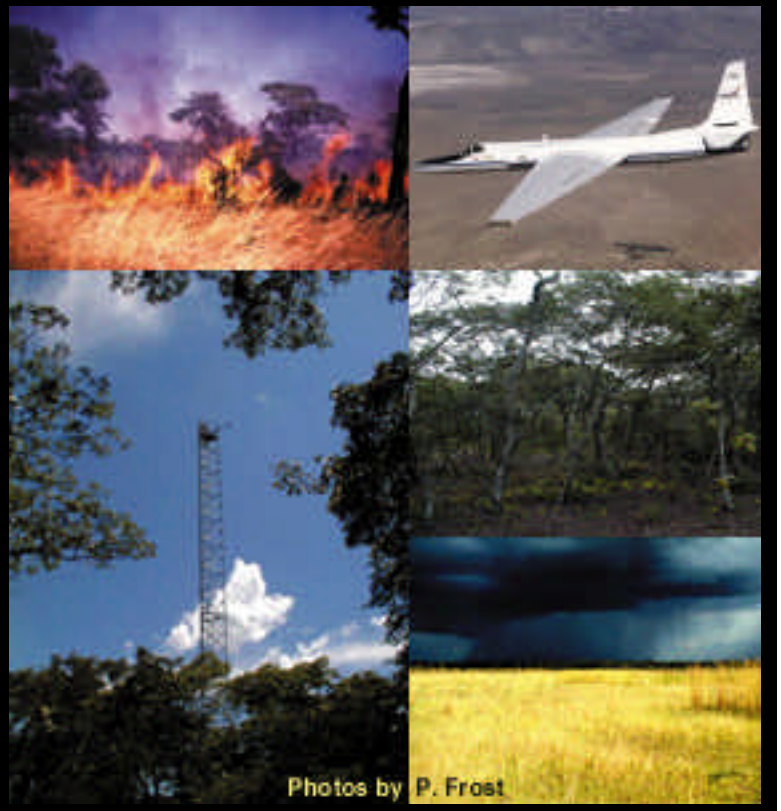
SAFARI 2000



Steve Platnick
MODIS Atmosphere Meeting
23 January 2001

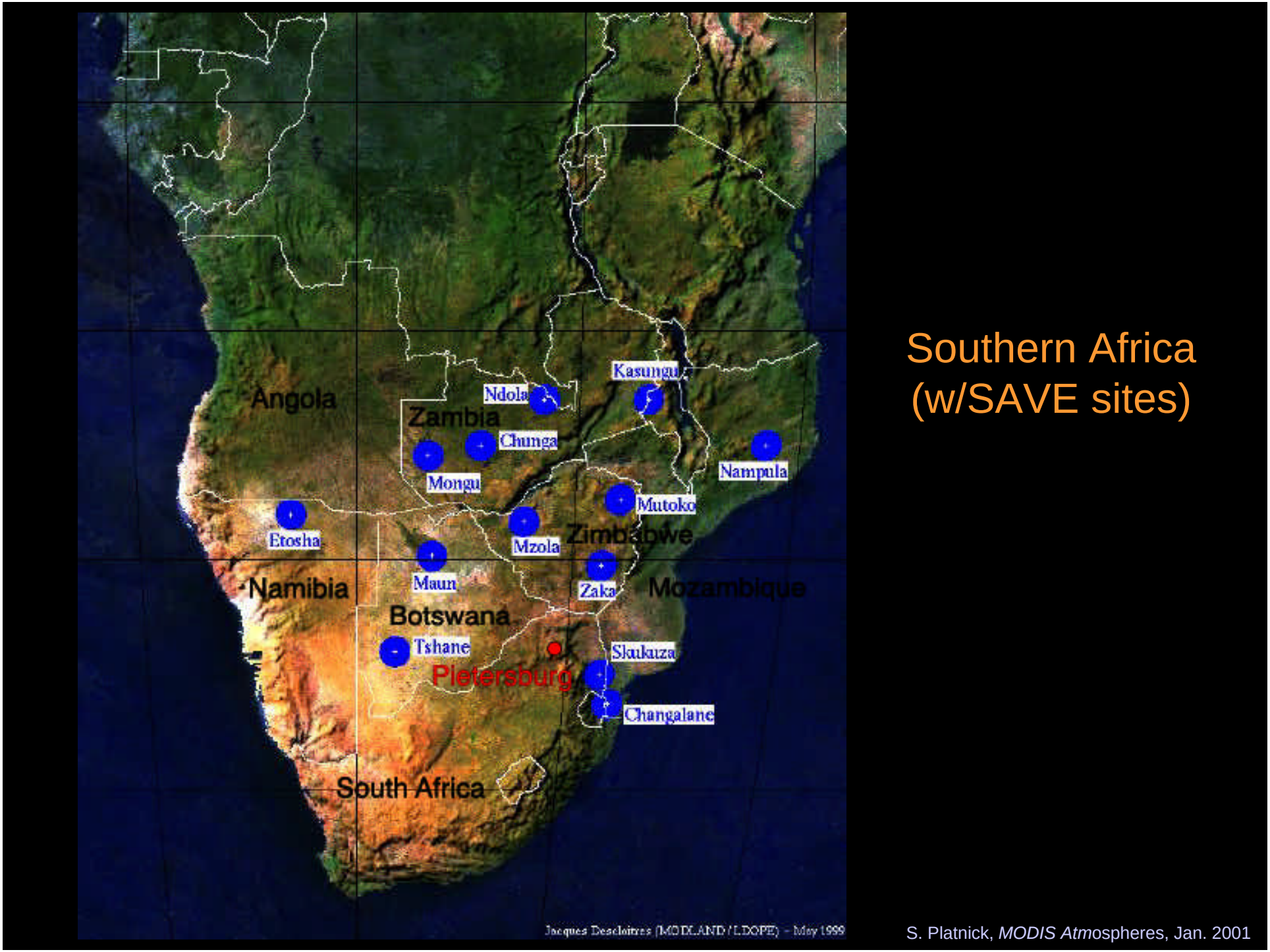
Southern African Regional Science Initiative 2000
SAFARI 2K

Aug-Sept. 1999 (dry) , Feb.-March 2000 (wet), Aug.-Sept. 2000 (dry)

follow-on to SAFARI 1992 umbrella organization (b.y.o.m.)

- integrate remote sensing, computational modeling, airborne sampling and ground-based studies
- link the biological, physical and chemical components of the regional ecosystems by integrating them within the semi-closed atmospheric gyre persistent over the region
- combine the expertise and knowledge base of regional and international scientists
- **EOS validation** (ground-based, aircraft)

S. Platnick, *MST Atmosphere Discipline Meeting*, Jan. 2001



Southern Africa
(w/SAVE sites)

S. Platnick, *MODIS Atmo*spheres, Jan. 2001

Skukuza tower
Kruger National Park

S. Platnick, *MODIS Atmo*spheres, Jan. 2001

Skukuza airport (SMART)

in situ aerosol, cloud probes (**FSSP**, **PCASP**, **PVM**, PMS **1-D, 2-D** ; **CCN** counter for cloud work)
chemistry, optical characterization
radiometers: **CAR**, **SSFR** (spectral flux), **AATS** (tracking sun photometer)

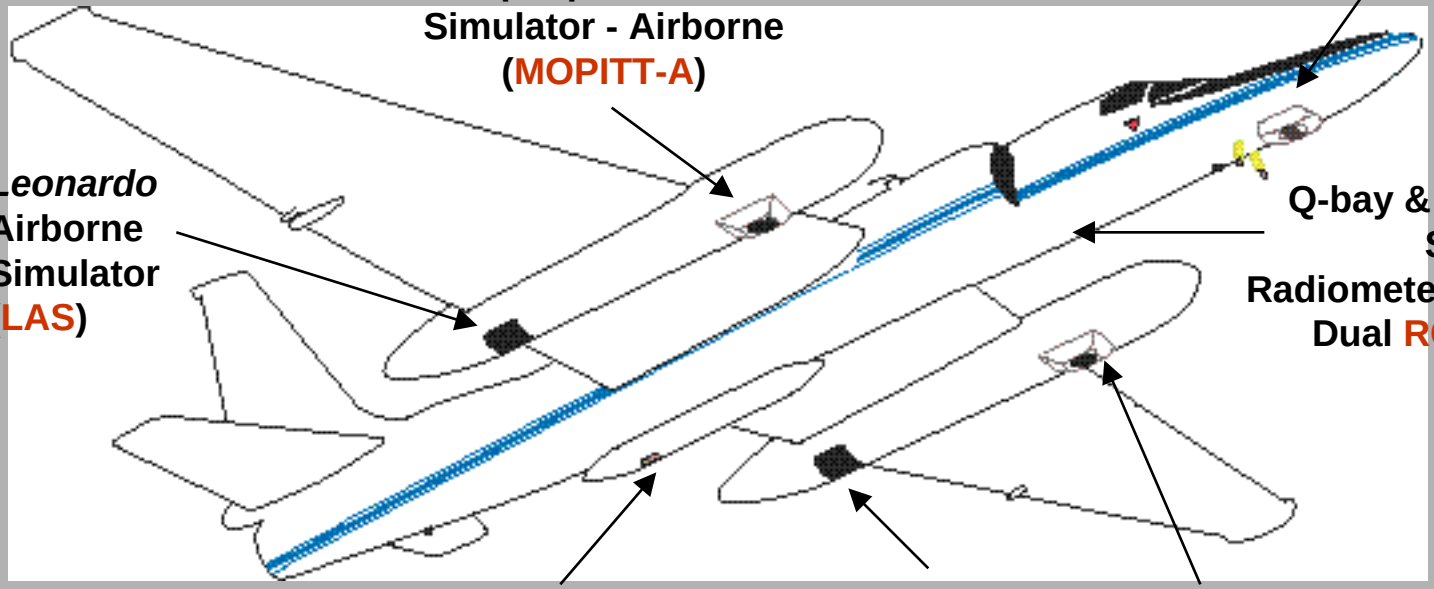
University of Washington CV-580

South African Weather Bureau Aerocommander JR-A (B)

JR-A: aerosol probes, chemistry
JR-B: cloud probes, CCN counter

NASA ER-2

SAFARI 2000
ER-2 Instrument Configuration



Airborne Multi-Angle Imaging Spectrometer (AirMISR)

Measurement of Pollution in the Troposphere Airborne Simulator - Airborne (MOPITT-A)

Leonardo Airborne Simulator (LAS)

Q-bay & E-bay: Solar Spectral Flux Radiometer (SSFR, x2), Dual RC-10 Camera

Scanning High resolution Interferometer Sounder (S-HIS)

MODIS Airborne Simulator (MAS)

Cloud Physics Lidar (CPL)

S. Platnick, *MODIS Atmo*spheres, Jan. 2001

August 2000

Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
		1	2	3	4	5
6	7	8	9	10	11	12 Open House
13	14	15	16	17 Mozambique channel	18	19 Down Day
20 Madikwe fire	21	22 Skukuza & KNP	23	24 Inhaca Island & Mozambique	25 Kaoma & Mongu, Zambia	26 Down Day
27 Sowa Pan & Okavanga Delta	28	29 KNP for TOMS coordination	30 Mid-term Science Review	31 Skukuza, aborted for MAS failure		

1
2 3 4 5 6 7 8
9 10 11 12 13 14 15
16 17 18 19 20 21 22
23 24 25 26 27 28 29
30 31

ER-2 flight summary

1 2
3 4 5 6 7 8 9
10 11 12 13 14 15 16
17 18 19 20 21 22 23
24 25 26 27 28 29 30

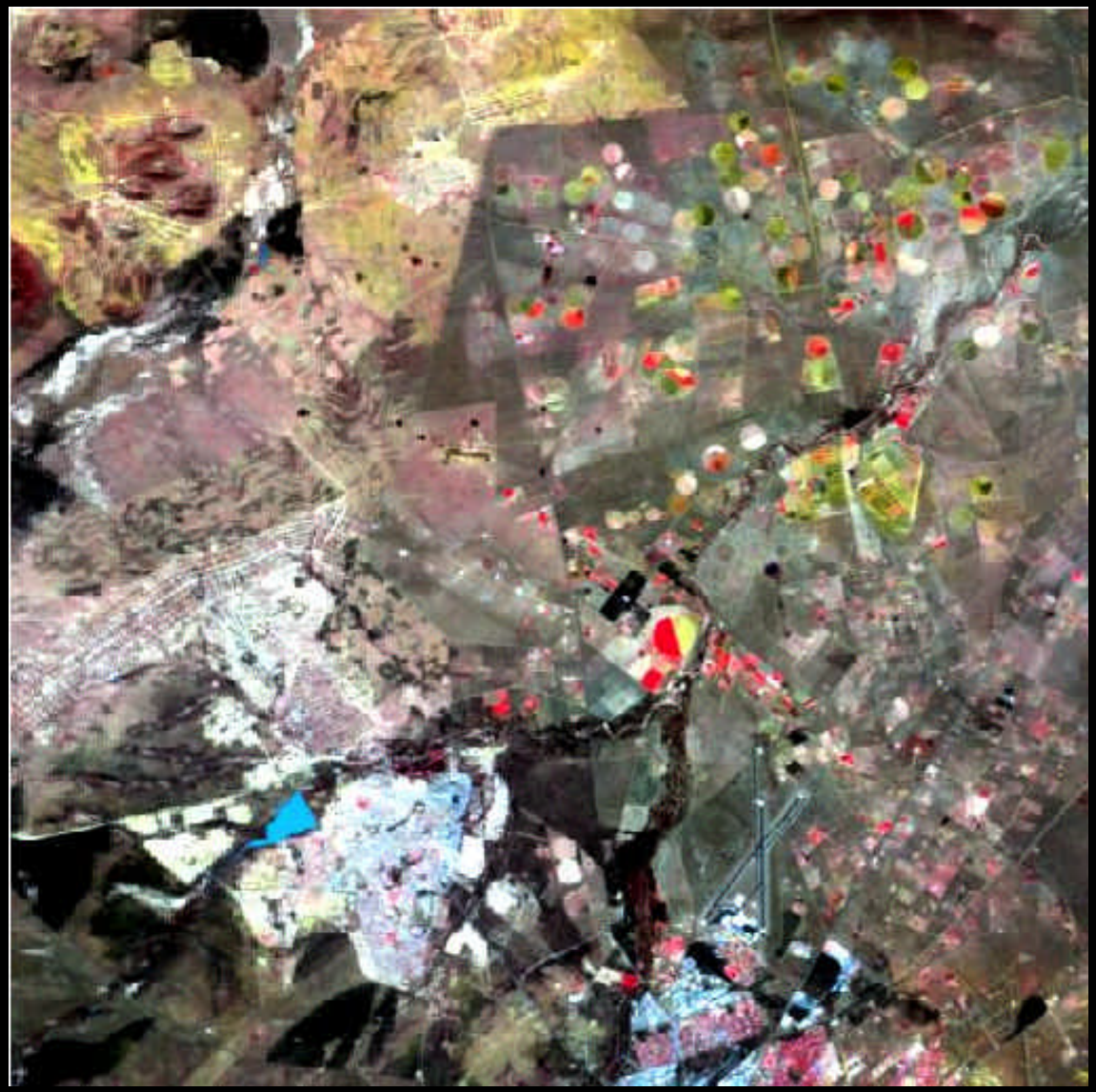
September 2000

Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
					nighttime flight over western Zambia 1	2
3	overpass of Sowa Pan & Kalahari transect 4	5	Kaoma burn & western Zambia 6	KNP & Mozambique 7	8	9
10	Namibian stratus & Kuiseb canyon 11	12	Namibian coast & Etosha 13	overflight of Angolan stratus 14	15	16
Namibia burn scars, Maun tower, & industry 17	ER-2 down day due to high forecast pm winds 18	ER-2 down day due to high forecast am winds 19	20	ER-2 overflight of Mozambique channel 21	ER-2 down day to fix HF antenna 22	Skukuza , Malibamatso Catchment 23
24	Skukuza & Inhaca Island 25	26	27	28	29	30

1 2 3 4 5
6 7 8 9 10 11 12
13 14 15 16 17 18 19
20 21 22 23 24 25 26
27 28 29 30 31

ER-2 flight summary, cont.

1 2 3 4 5 6 7
8 9 10 11 12 13 14
15 16 17 18 19 20 21
22 23 24 25 26 27 28
29 30 31



MAS
Pietersburg, RSA
(17 Aug 2000)

N

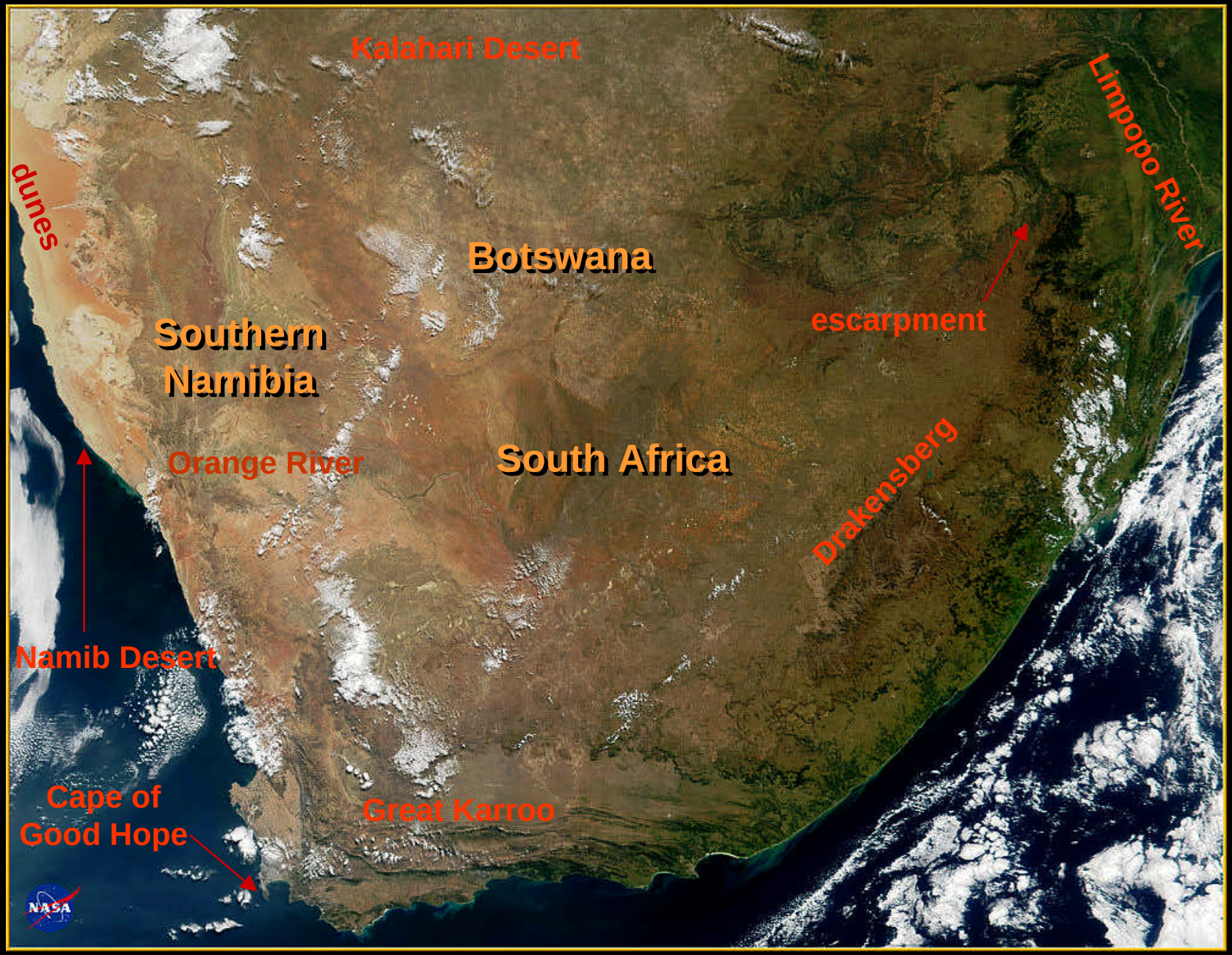
Flight Direction

36 km

RGB: 0.74, 0.66, 0.55 µm

S. Platnick, *MODIS Atm*ospheres, Jan. 2001

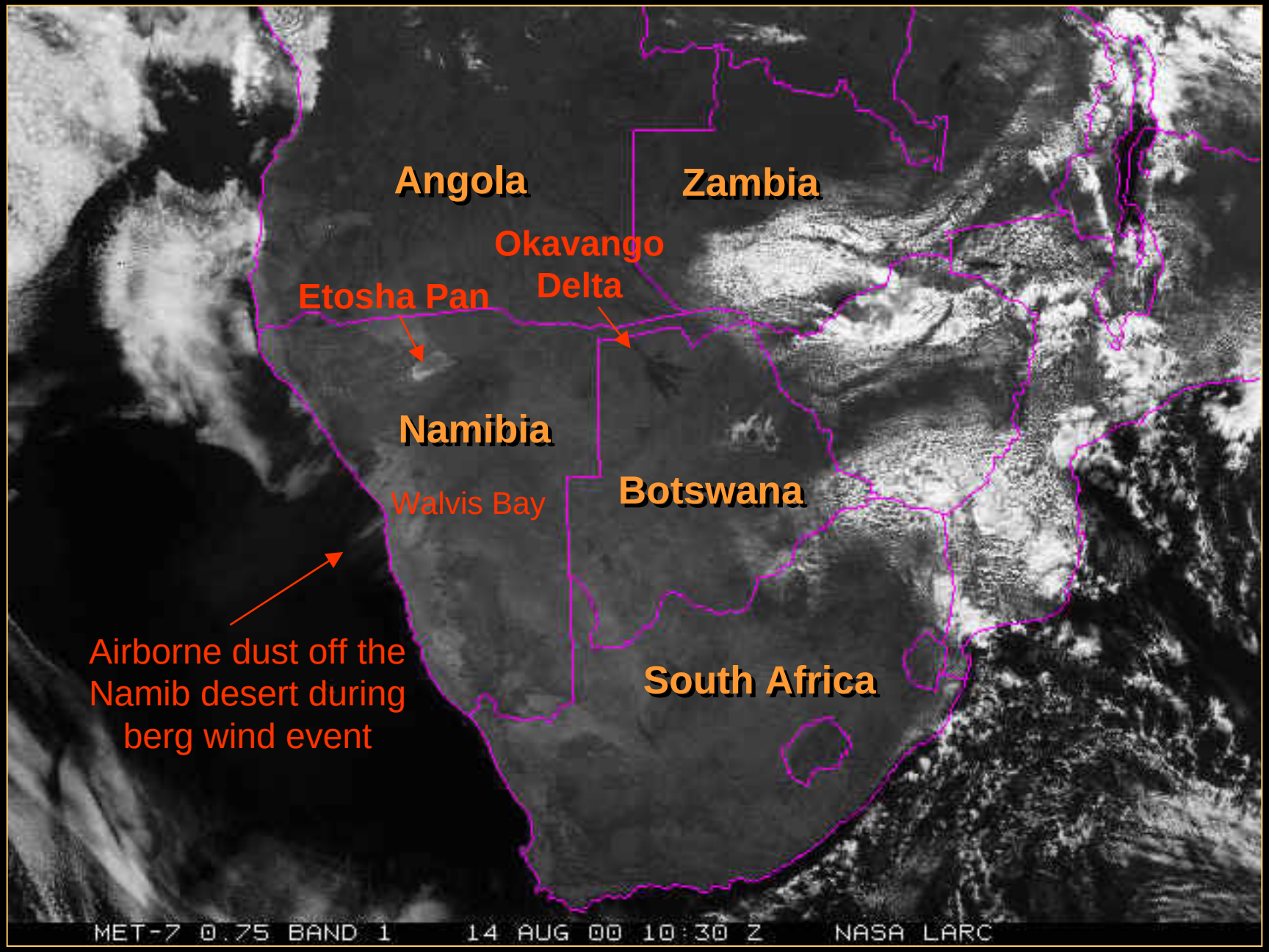
Some geological features of Southern Africa



MODIS day 135

S. Platnick, *MODIS Atmospheres*, Jan. 2001

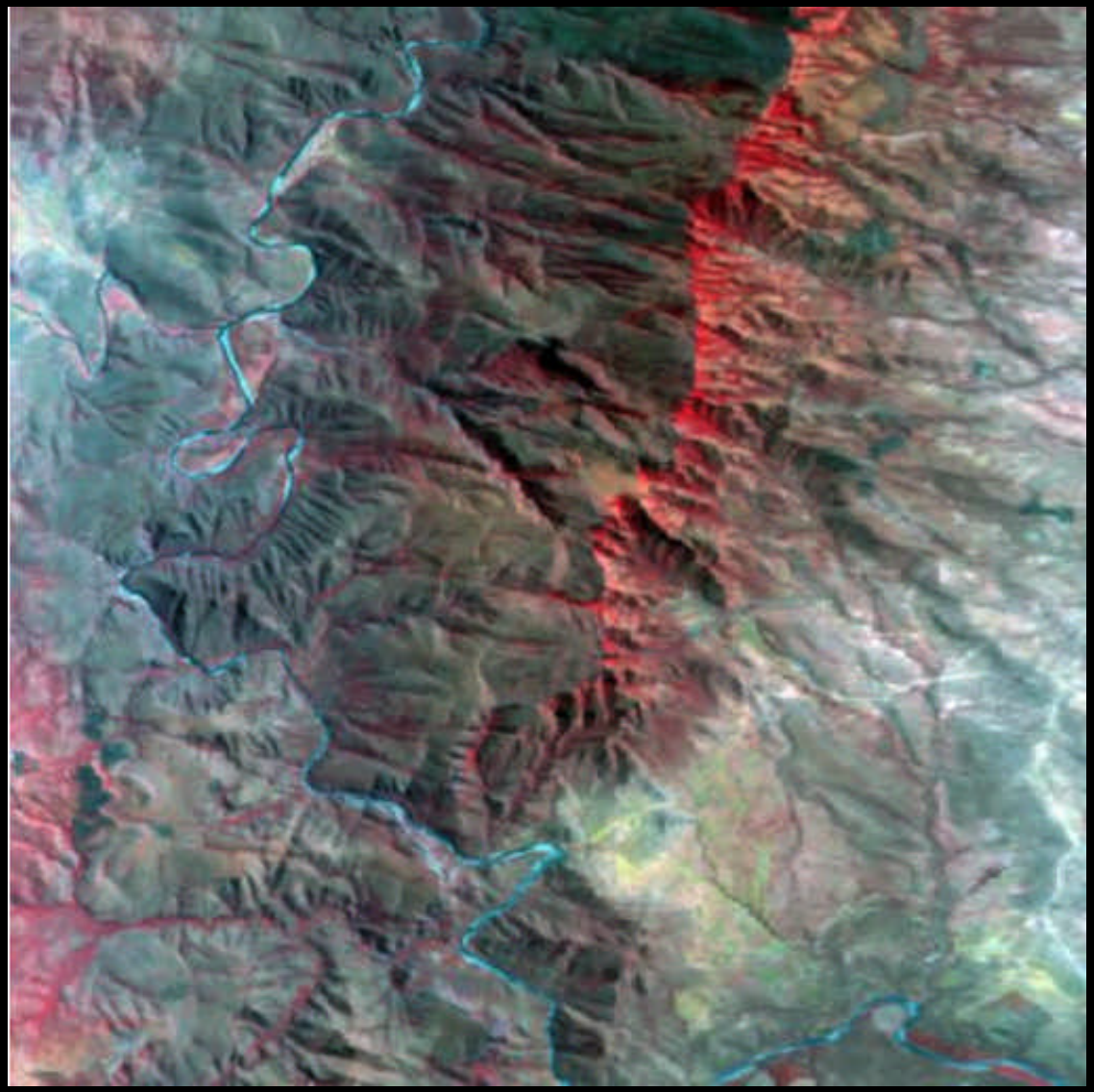
more features of Southern Africa



S. Platnick, *MODIS Atmo*spheres, Jan. 2001

Pietersburg, 10 Sept 2000

Fire in vicinity of
Pietersburg, RSA
21 Sept 2000
(JR-B)



MAS
Oliphants River & Escarpment, RSA (17 Aug 2000)

297°

Flight Direction

20.5 km

RGB: 0.74, 0.66, 0.55 µm

S. Platnick, *MODIS Atmospheres*
Jan. 2001

Escarpment view from CV-580

S. Platnick, *MODIS Atmo*spheres, Jan. 2001 (photo by J. Li)

"God's Window", 27 Sept 2000

RGB: natural color

36 km

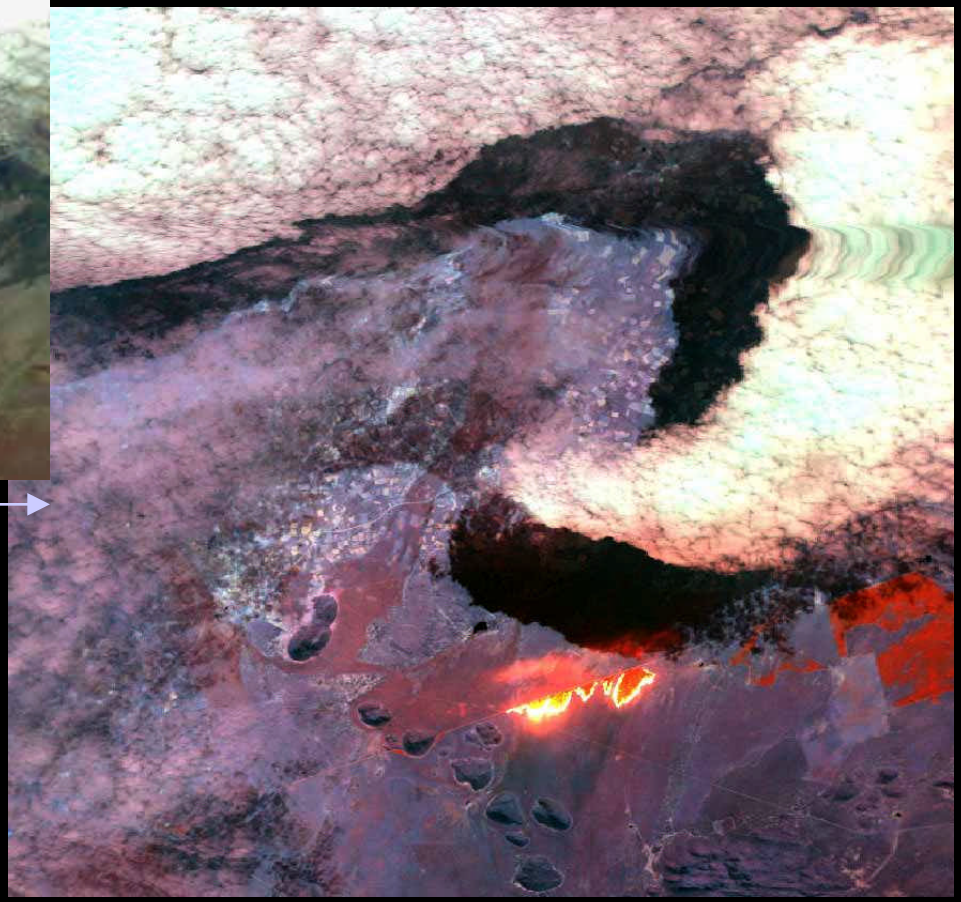
6.5°

Flight Direction

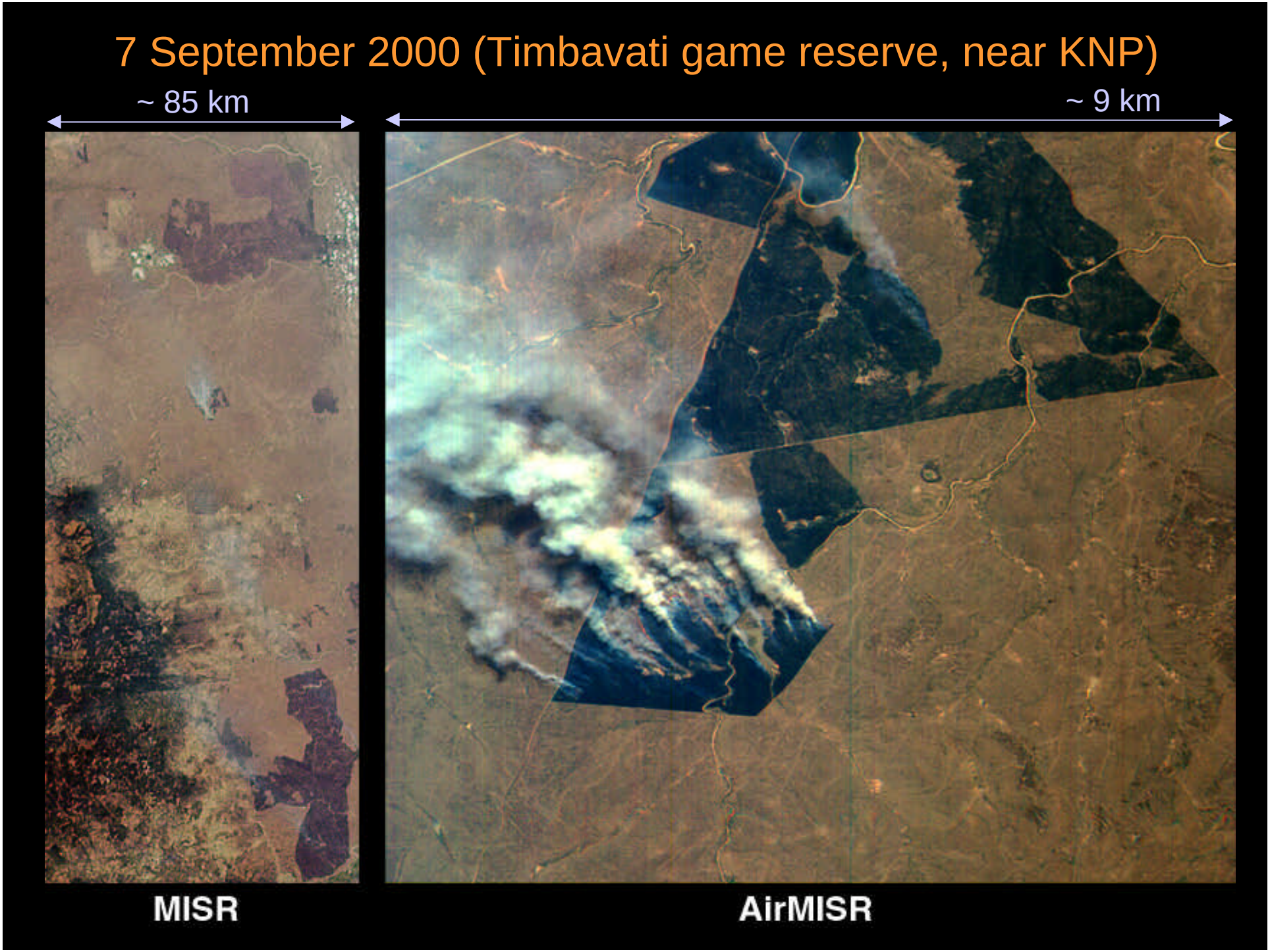
MAS

fire example , 20 Aug 2000
(Madikwe game reserve, RSA)

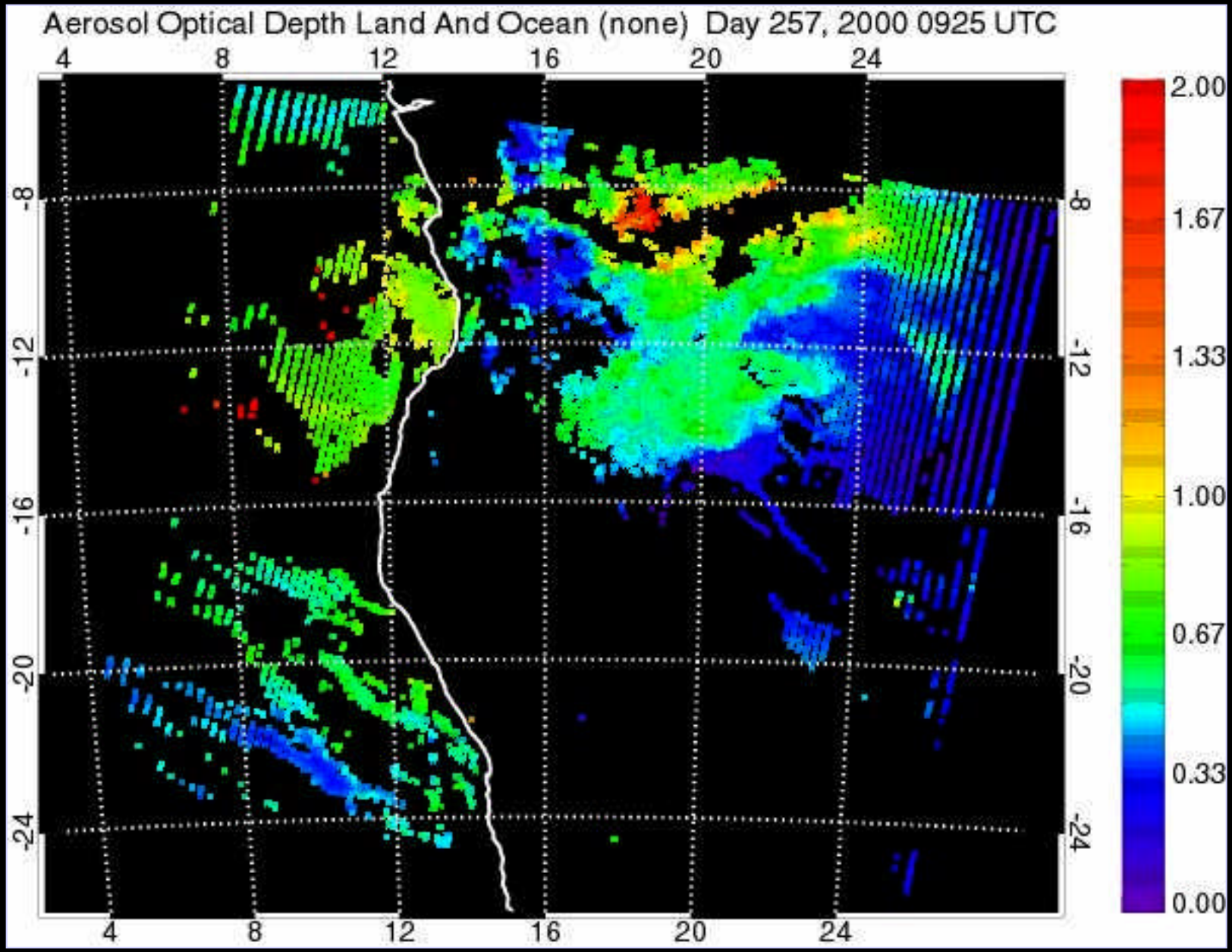
RGB: 3.7, 2.2, 1.6 µm

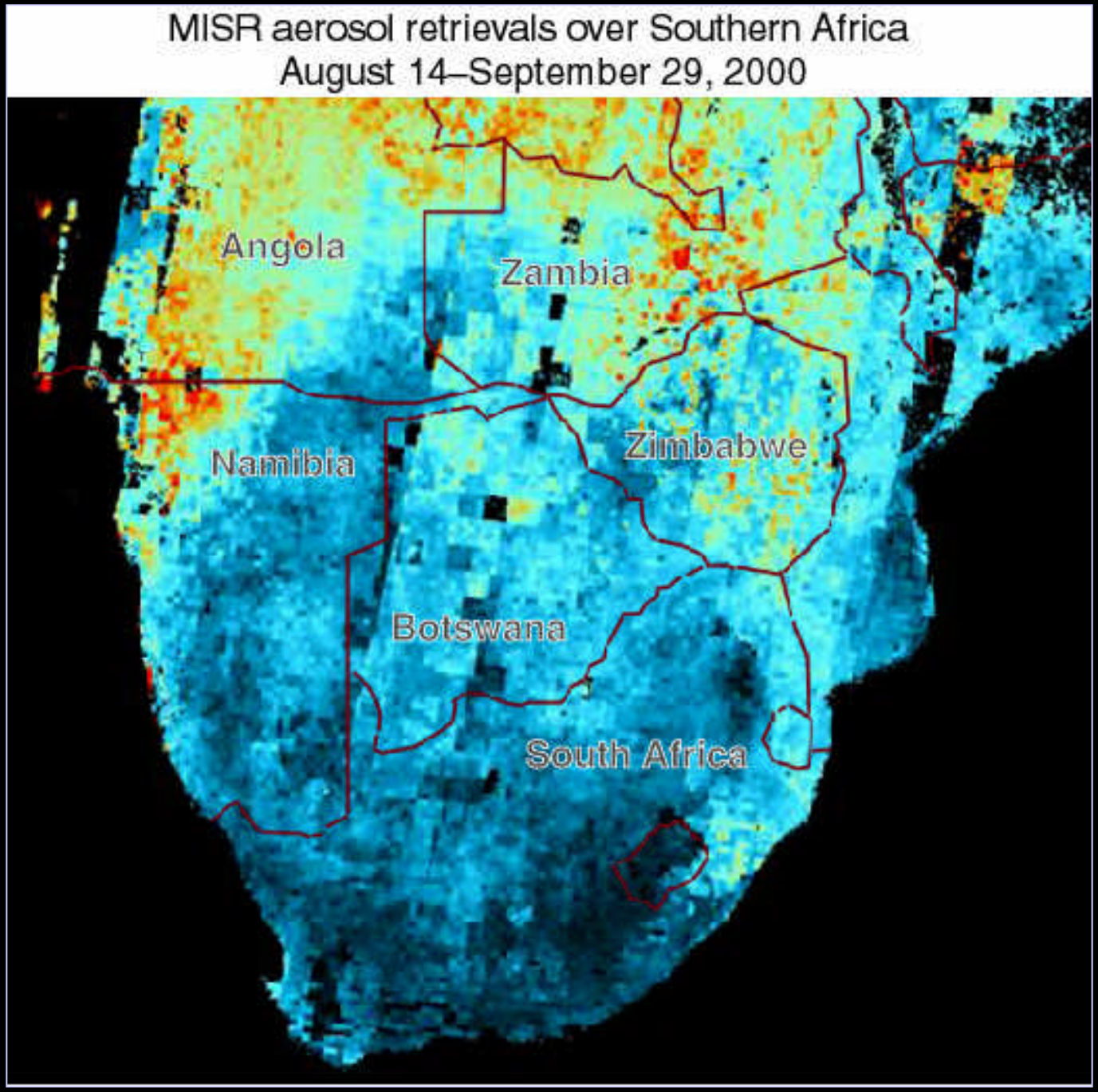


7 September 2000 (Timbavati game reserve, near KNP)



MODIS Aerosol retrieval, 13 September 2000

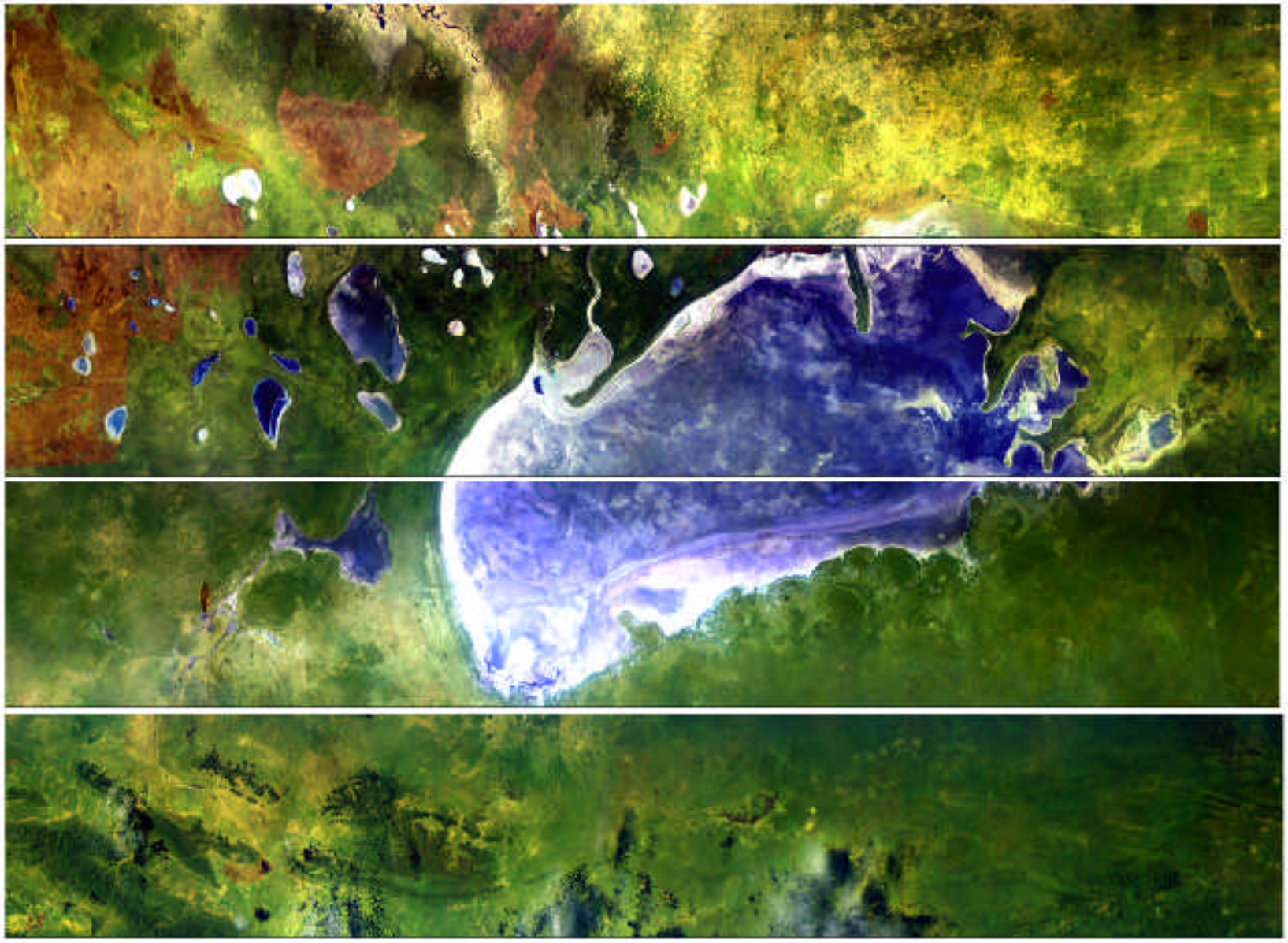



MISR aerosol retrievals over Southern Africa
August 14–September 29, 2000
Angola
Zambia
Namibia
Zimbabwe
Botswana
South Africa

MODIS Airborne Simulator Etosha Pan RGB (2.13 μm, 1.63 μm, 0.55 μm)

13 Sept. 2000 (1125 - 1228 GMT) and 14 Sept. 2000 (1312-1330)

N



Trk # 8 (Inverted)

Trk # 9

Trk # 10 (Inverted)

Trk # 10 (14 Sept.)

152 Km

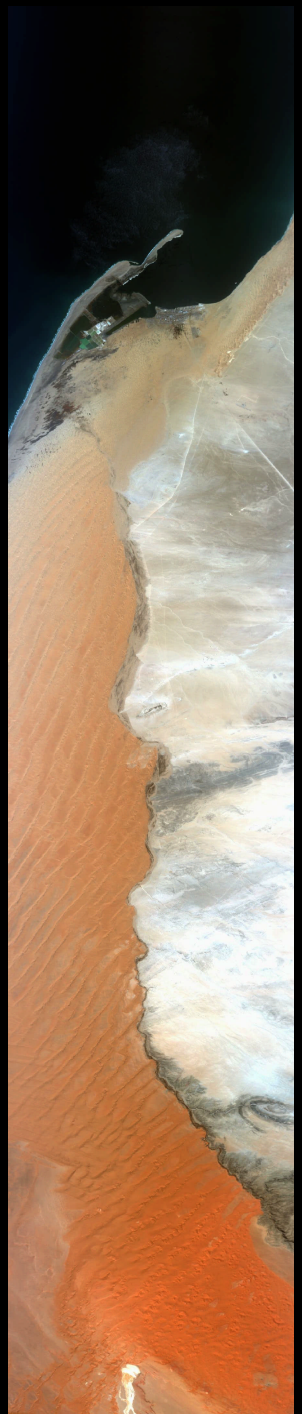
213 Km

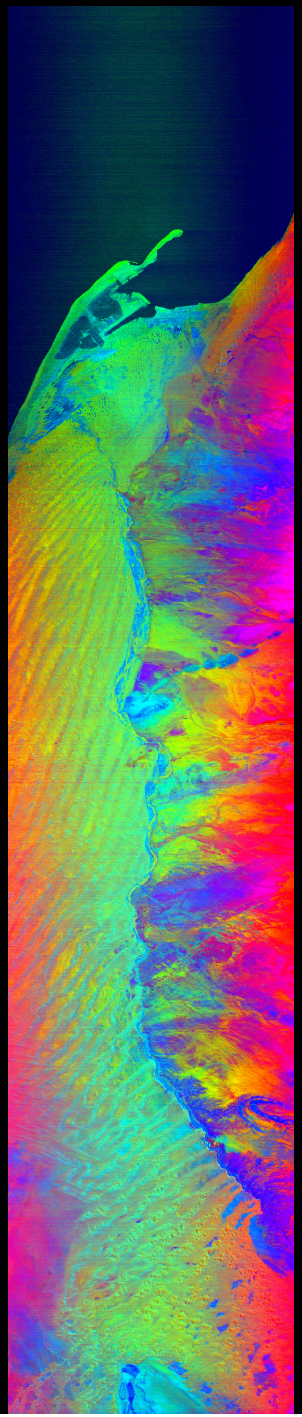
Etosha Pan, Namibia

S. Platnick, *MODIS Atmo*spheres, Jan. 2001

NW

Flight Direction





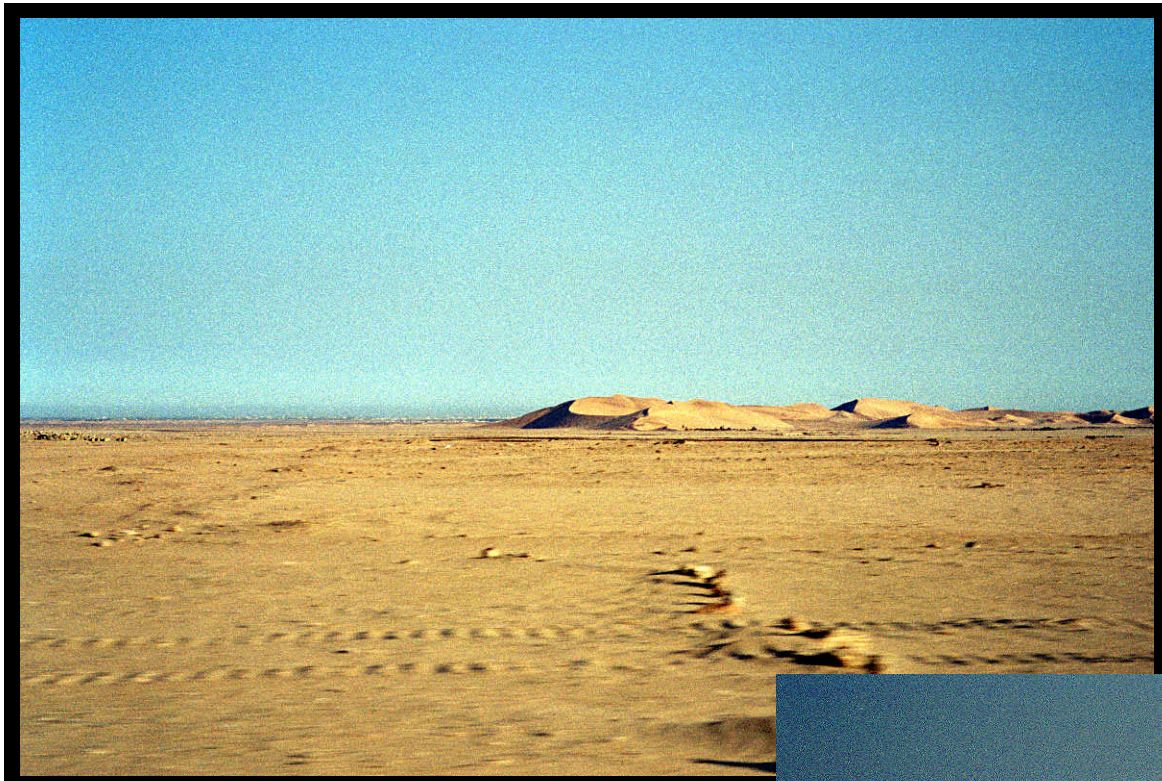
MAS

Walvis Bay, Namibia
& Kuiseb River Canyon
(11 Sept 2000)

RGB: natural color

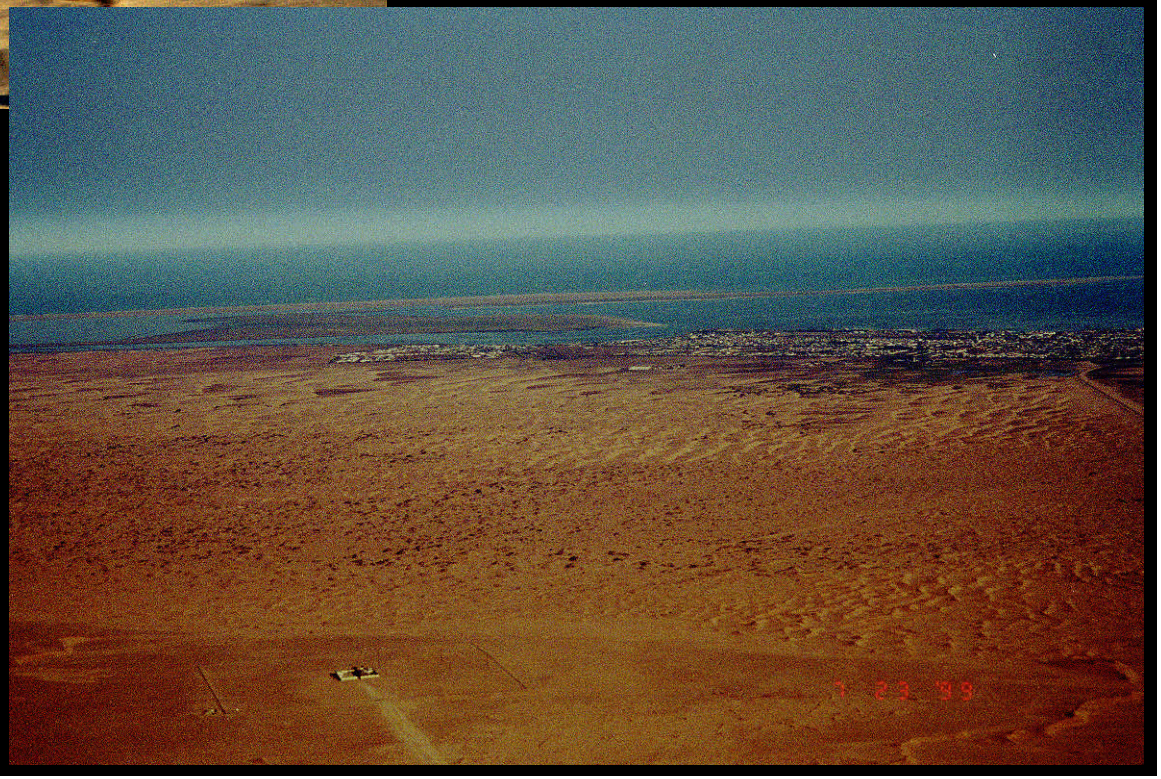
RGB: 11, 9.7, 8.5 µm

S. Platnick, *MODIS Atmo*spheres, Jan. 2001



along highway to Walvis Bay airport

Walvis Bay, Namibia from the air



Coastal Namibia
near Swakopmund

S. Platnick, *MODIS Atmo*spheres, Jan. 2001

Hydrogen Sulphide Along Namibia's Coast

Historical Background

Documentation from the early 20th century is quaint and informative:

"A strong odour of sulphur was distinctly noticeable in the atmosphere during the night preceding the first wash-up on the beach, while the sea itself assumed a particularly greenish tinge in the daytime."

"There is comparatively often, in Walfisch Bay and its precincts, a period when the fish become dazed and some are thrown up, dying, onto the beach..... I have always eaten the fish washed up on the beach....These fish have never made me or my family ill..."

".....Somewhat reminiscent of manna from Heaven, it is a unique sight to observe the shores littered with fish of such universal delicacy, yet all too unfortunate rarity. Besides the soles, which are alive when caught, and of perfect freshness, many other denizens of the deep are likewise brought ashore at high tide, and include rays, gurnets, harders, sharks and swarms of smaller fry, mostly in a semi-stupefied state."

A spectacular event recorded was the eruption of a mud "island" off Pelican Point in 1900:

"A very strong odour of sulphuretted hydrogen pervaded the spot .... the smell from the island was noticed at Swakopmund....Small pieces broke off and within a week the island had disappeared".

Introduction

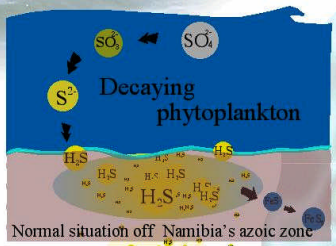
What causes the periodic "rotten egg" smell along the central Namibian coast?

Regular eruptions of hydrogen sulphide are a common natural phenomenon in the coastal waters between Conception Bay and Cape Cross. Following inshore "sulphur/Schwefel/swael" events, as they are locally termed, washups of dead and dying fish, rock lobster and other invertebrates are common on the beaches.

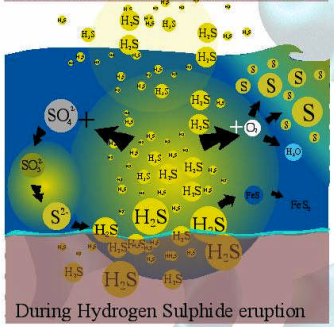
These events are marked by the obnoxious smell, collections of birds eagerly feeding at the surface, and the water assuming a milky turquoise colour, They are short-lived, lasting usually one to three days.

Processes

* organic matter sinks to the bottom, decaying en route by aerobic bacteria which deplete dissolved oxygen.
* on the seabed and in the accumulated ooze anaerobic sulphate-reducing bacteria convert sulphates to sulphides, ultimately producing hydrogen sulphide
* hydrogen sulphide gas is liberated into the water column
* some gas escapes onto the atmosphere; some is oxidized to microgranules of elemental sulphur which give the water its milky appearance, and some is utilized by sulphur bacteria



Normal situation off Namibia's azoic zone


During Hydrogen Sulphide eruption

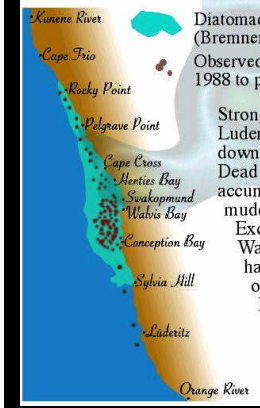
Effects

* To the local community hydrogen sulphide coming from the sea is commonplace and elicits little more than comment on the nasty smell. The corrosive effects on metals from the sulphurous gases in the moist foggy atmosphere are legendary.

* H2S is a potent respiratory toxin which readily diffuses across biological membranes to inhibit aerobic cellular metabolism by blocking a cytochrome c oxidase enzyme. High concentrations in the sea effectively paralyze the marine animals in the localized vicinity.
* Mortalities of inshore animals occur annually with varying intensity - most commonly in late summer. A variety of fish and invertebrates are the usual victims, with the stranded rock lobster eagerly harvested by the public.
* The local fauna must be adapted to sulphide/anoxia/hypoxia stresses.

The low- diversity/high biomass communities appear to be utilizing a food-rich edge habitat.

Where it Occurs

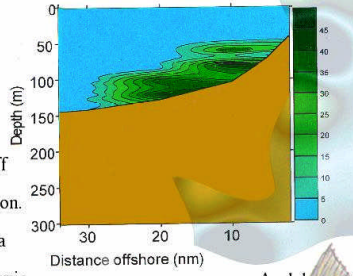


Diatomaceous mud belt (Bremner 1980)

Observed sulphide events 1988 to present

Strong perennial upwelling off Luderitz results in massive downstream primary production. Dead and decaying cells accummulate metres-deep in a muddy diatom ooze.

Exceptionally thick and anoxic Walvis Bay, an inshore area here has been known as the "azoic zone" because of the lack of macrofauna on the bottom. Recent1998/9 observations show hydrogen sulphide occurring as far south as Possession Island and as far north as Rocky Point.



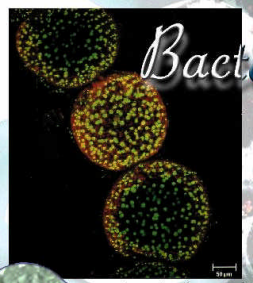
Questions

* What triggers a hydrogen sulphide eruption?
* How extensive are sediments which potentially liberate hydrogen sulphide into the water column?
* Will activities on the seabed, such as mining, disturb these sediments to release dangerously large amounts of hydrogen sulphide?

And how close are "important" benthic areas e.g. rock lobster and fishing grounds?

* To what extent, both temporal and spatial, is the surrounding water robbed of oxygen when hydrogen sulphide is liberated, and how does this oxygen deficiency impact on the marine communities?

Bacteria



In 1997 the largest bacteria in the world *Thiomargarita namibiensis* were discovered in the surface layers of the diatomaceous ooze off Namibia.

These bacteria oxidize hydrogen sulphide with nitrate, which they opportunistically absorb and store in their large central vacuoles.

Microgranules of sulphur deposit in the thin outer cytoplasm, giving the round bacteria a shiny white appearance and earning them the nickname sulphur pearls of Namibia"

Exceptional microbial biomasses of up to 175g per square metre occur.

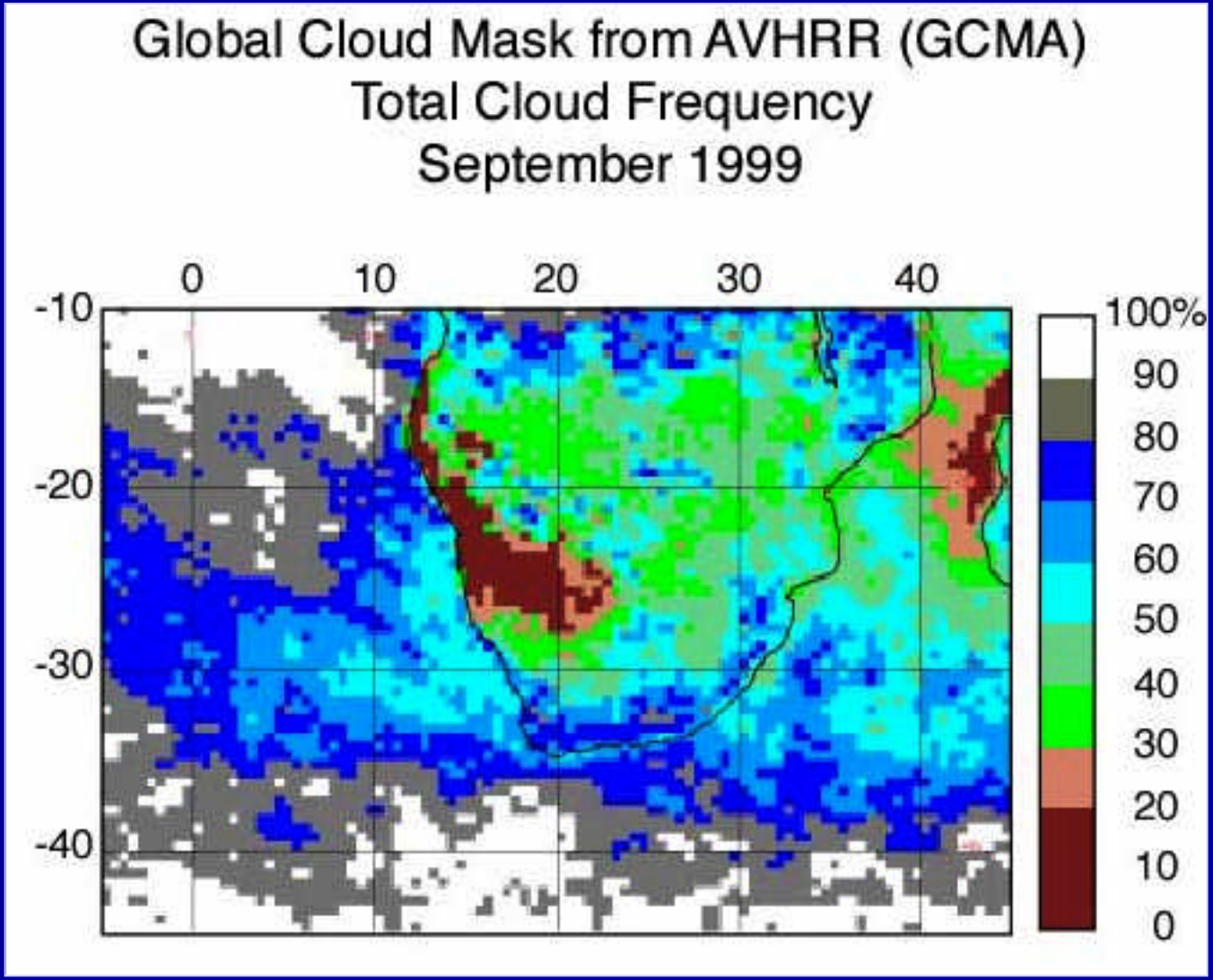
Bronwen Currie
Ministry of Fisheries and Marine Resources
P.O. Box 912
Swakopmund

DRIFTWOOD MULTIMEDIA

BENEFIT

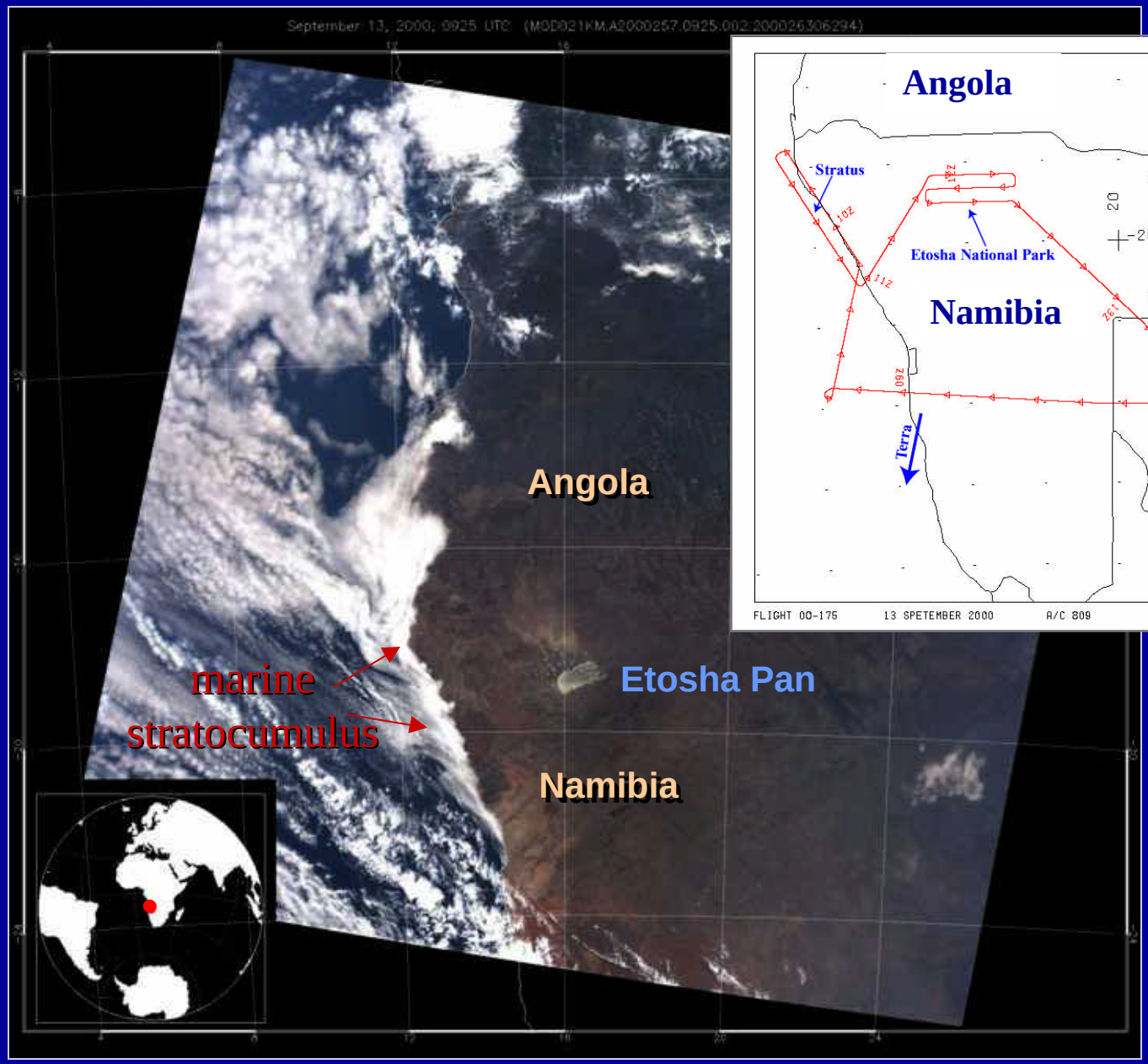
S. Platnick, *MODIS Atmo*spheres, Jan. 2001

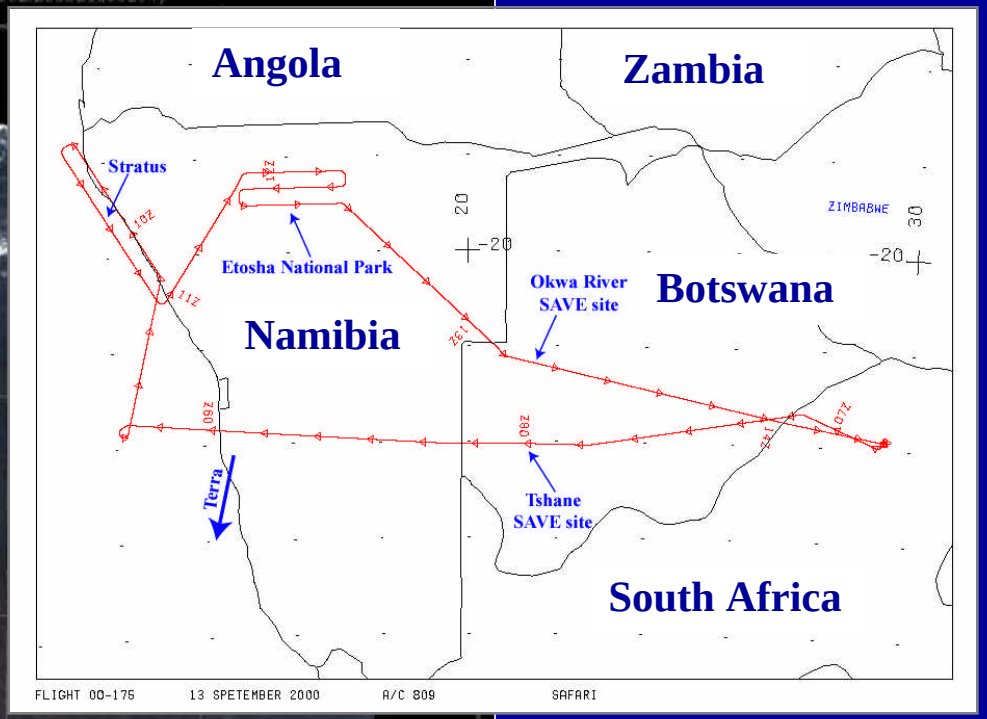
cloud climatology of SAFARI region (Ackerman and Frey)



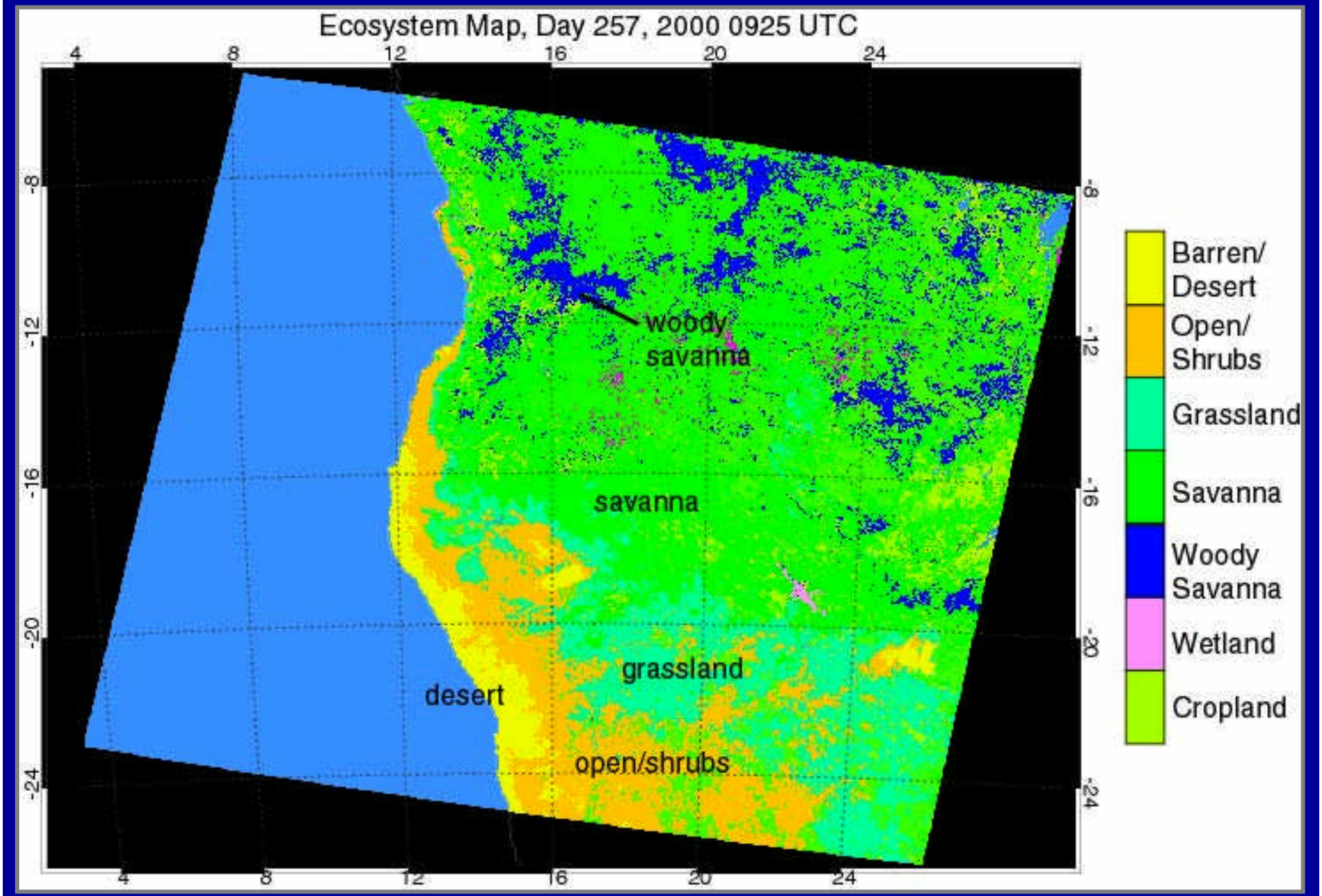
S. Platnick, *MODIS Atmo*spheres, Jan. 2001

MODIS SAFARI granule RGB composite
13 September 2000, 0925 UTC

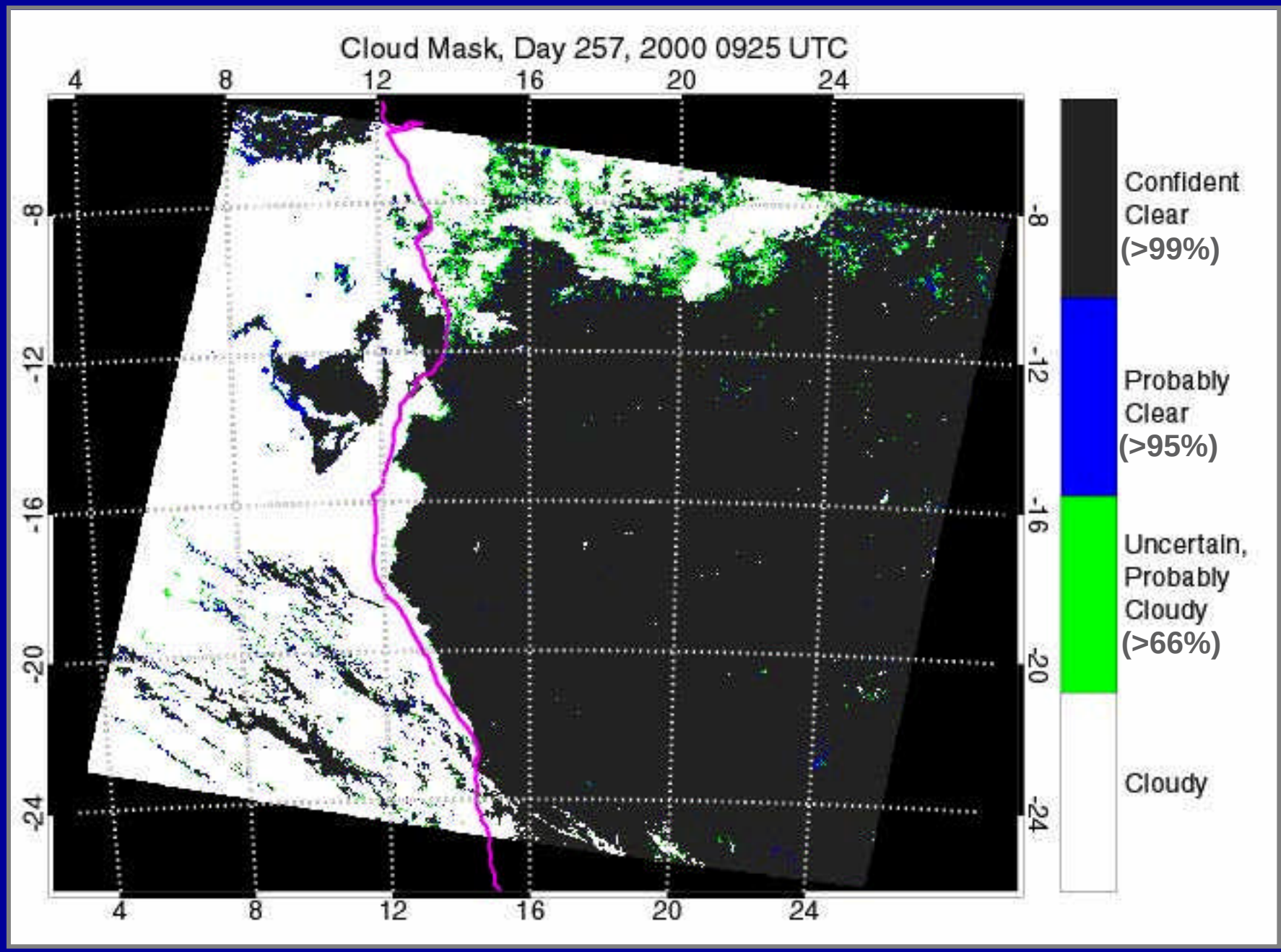




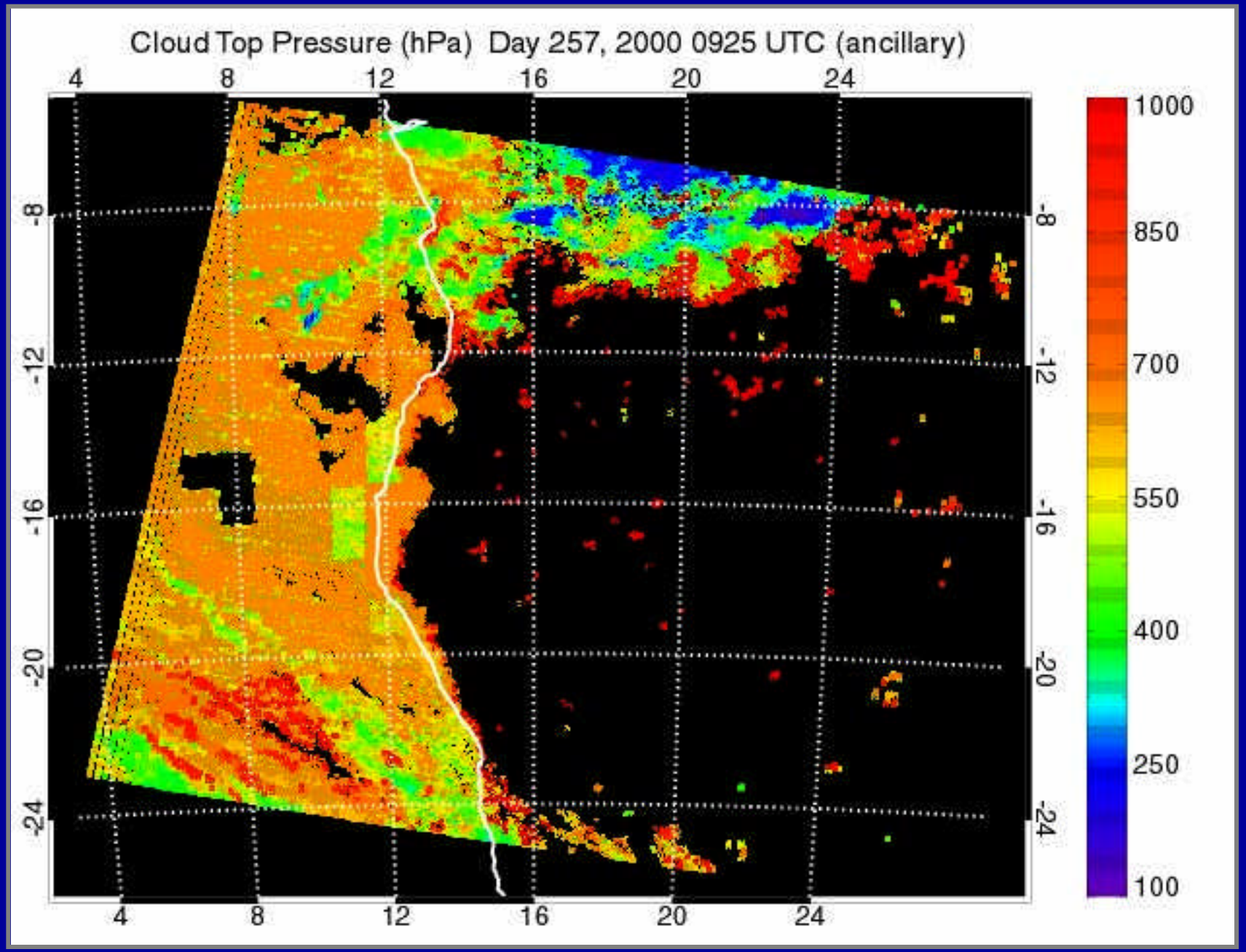
ER-2 ground track

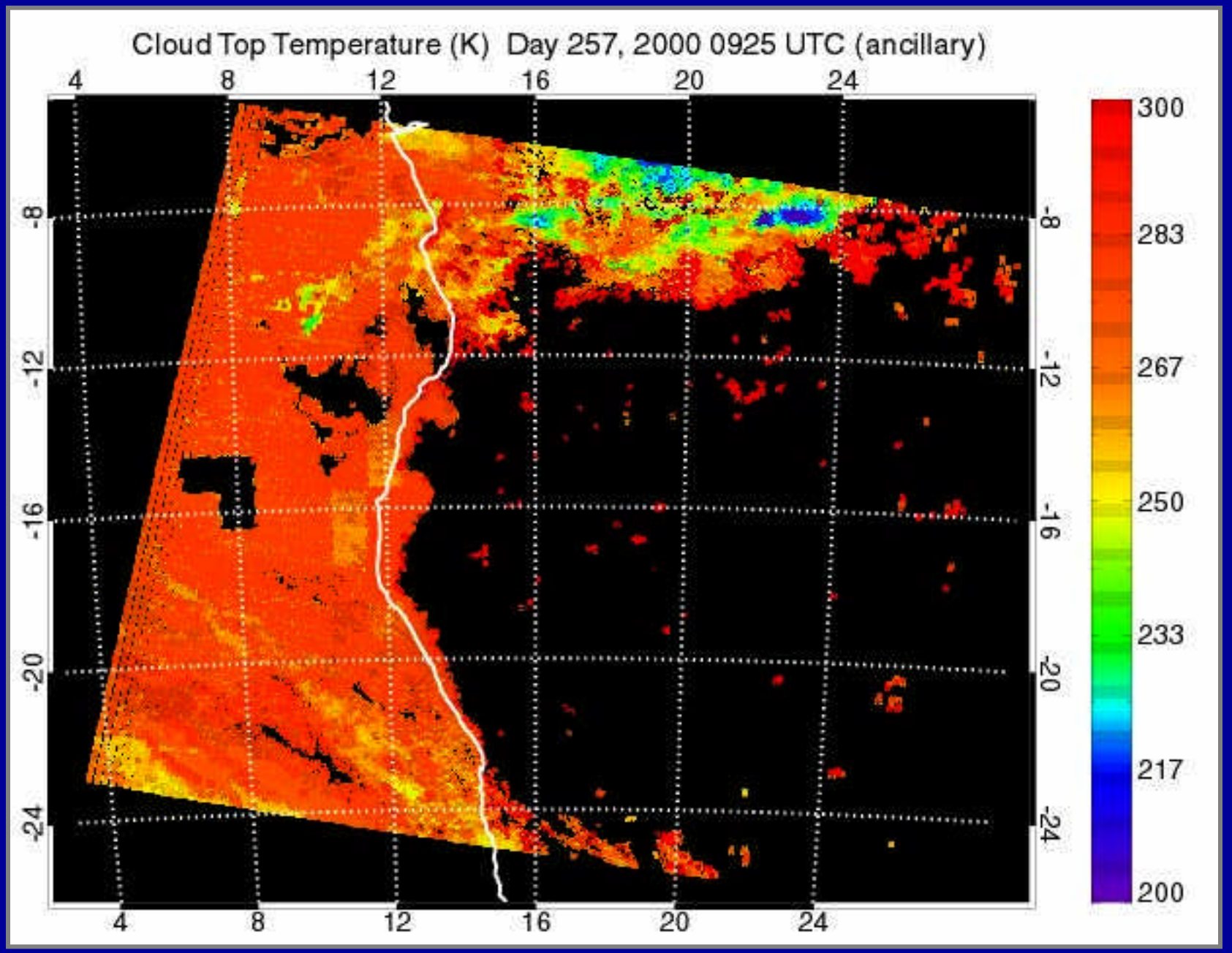


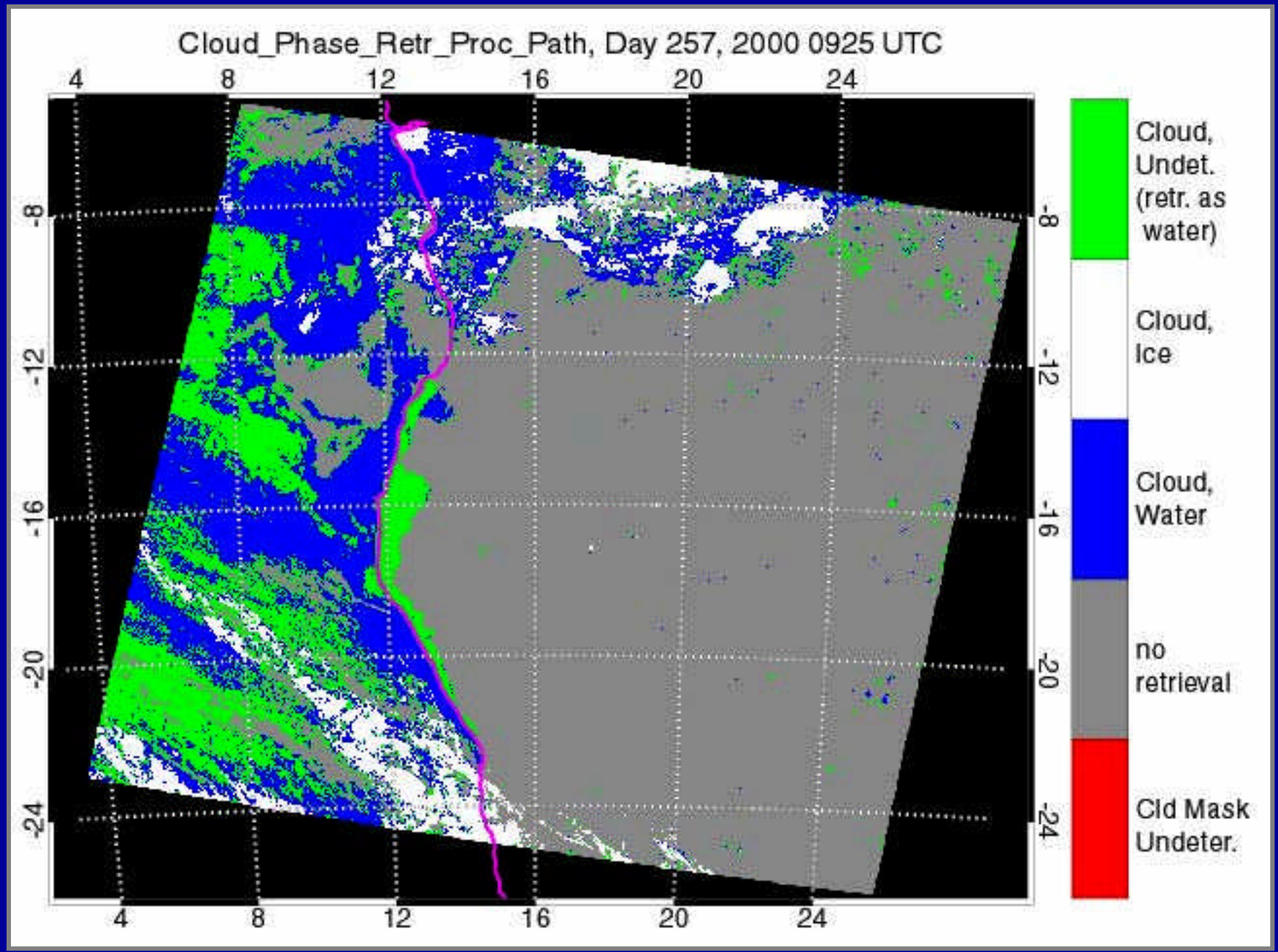
S. Platnick, *AGU*, 19 Dec. 2000

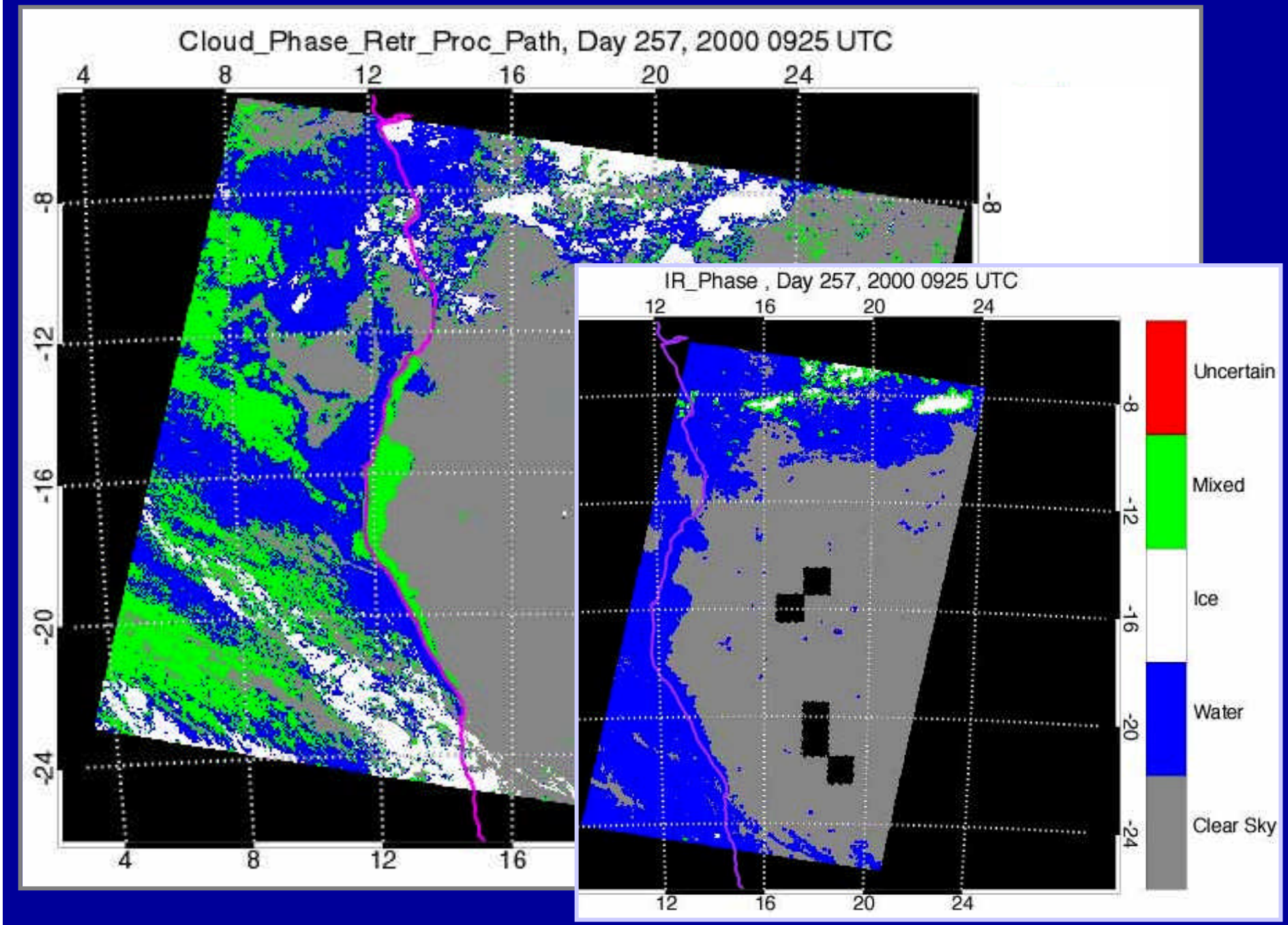


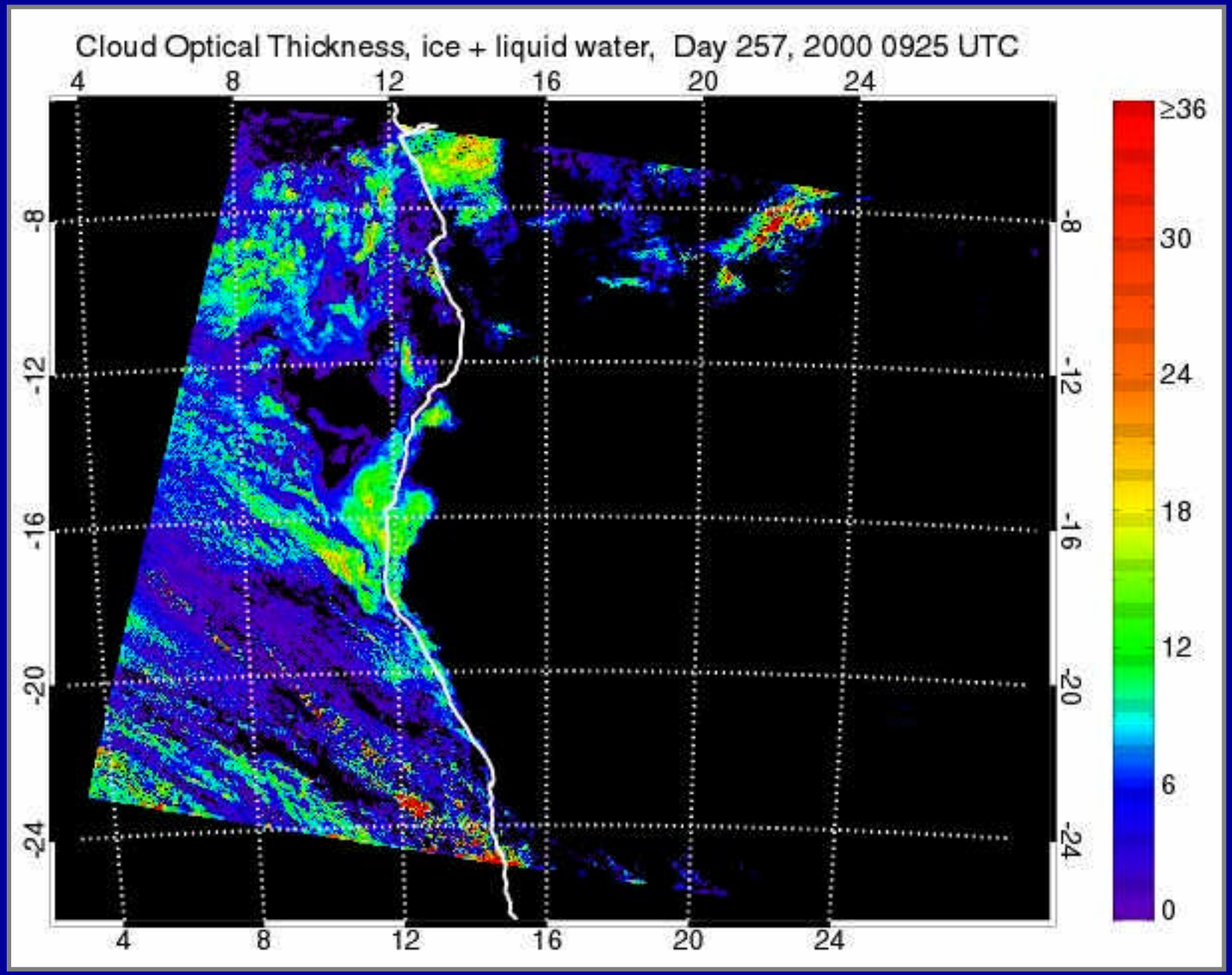
S. Platnick, *AGU*, 19 Dec. 2000

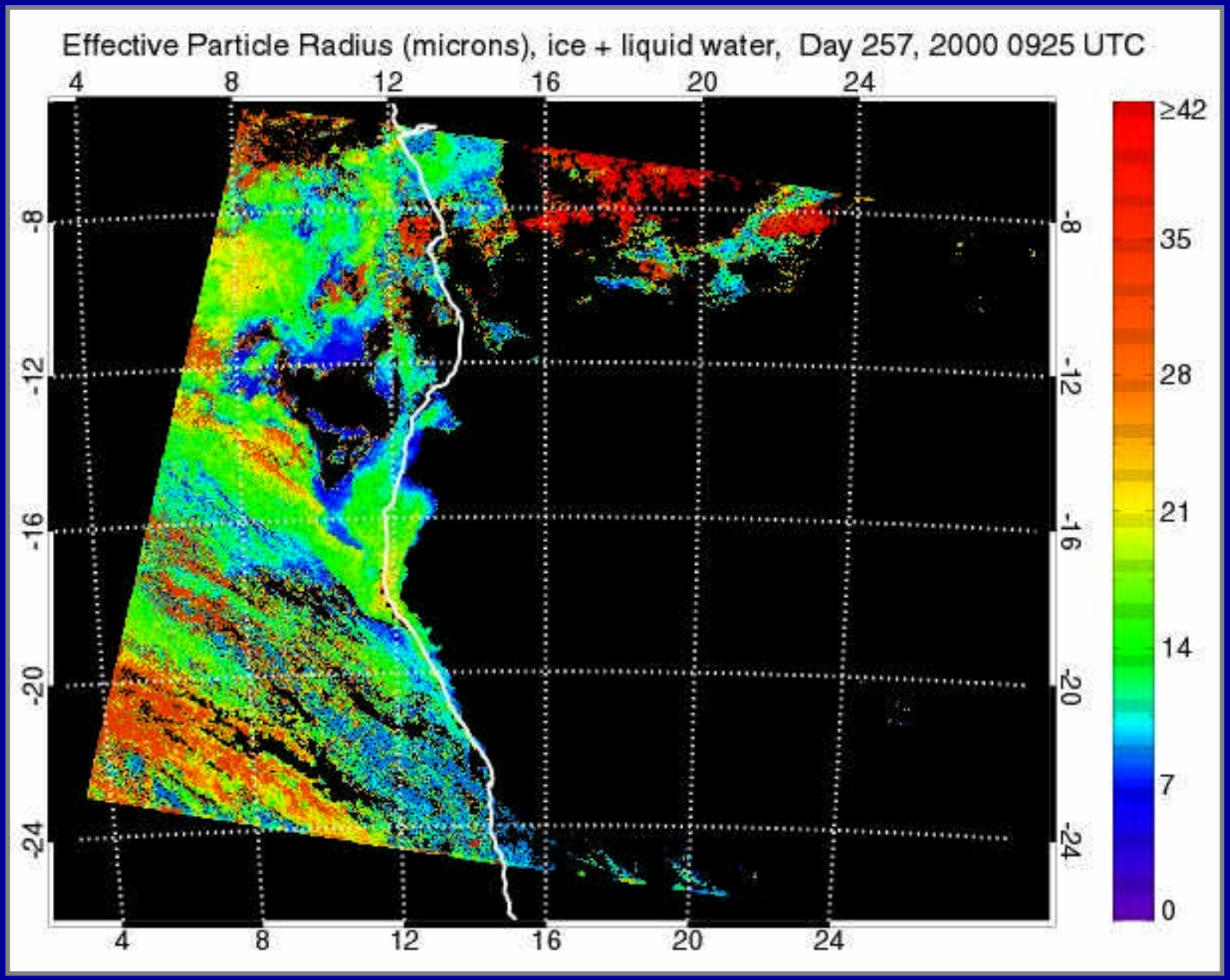

Cloud Top Pressure (hPa) Day 257, 2000 0925 UTC (ancillary)
4
8
12
16
20
24
-8
-12
-16
-20
-24
1000
850
700
550
400
250
100


Cloud Top Temperature (K) Day 257, 2000 0925 UTC (ancillary)
4
8
12
16
20
24
-8
-12
-16
-20
-24
300
283
267
250
233
217
200

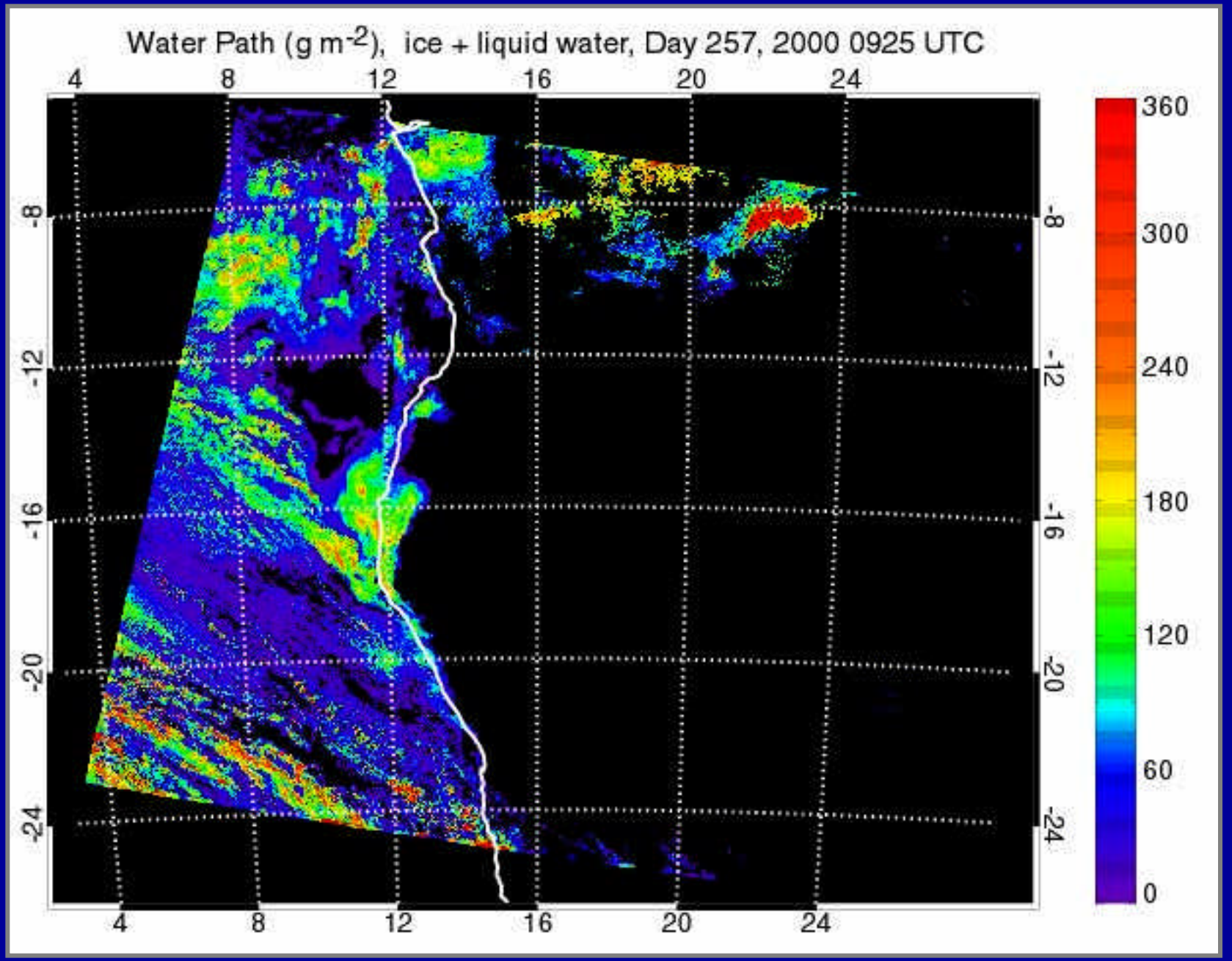

Cloud_Phase_Retr_Proc_Path, Day 257, 2000 0925 UTC
4
8
12
16
20
24
-8
-12
-16
-20
-24
Cloud, Undet. (retr. as water)
Cloud, Ice
Cloud, Water
no retrieval
Cld Mask Undeter.


Cloud_Phase_Retr_Proc_Path, Day 257, 2000 0925 UTC
4
8
12
16
20
24
-8
-12
-16
-20
-24
IR_Phase , Day 257, 2000 0925 UTC
Uncertain
Mixed
Ice
Water
Clear Sky


Cloud Optical Thickness, ice + liquid water, Day 257, 2000 0925 UTC
4
8
12
16
20
24
-8
-12
-16
-20
-24
≥36
30
24
18
12
6
0



S. Platnick, *AGU*, 19 Dec. 2000


Water Path (g m-2), ice + liquid water, Day 257, 2000 0925 UTC
4
8
12
16
20
24
-8
-12
-16
-20
-24
360
300
240
180
120
60
0